U.S. Department of Transportation
Maritime Administration
Office of Shipbuilding and Marine Technology

New Generation Polar Research Vessel

Issue 1 June 2003

Introduction

This is the first newsletter of a series that is designed to keep our readers informed of recent and pending events and project activities related to the design of a new polar research vessel.

This issue contains articles on the beginning stages of the design, the design team's visit to Scandinavian icebreakers, and the current status of the program.

For your convenience, acronyms are identified on page 6.

Your comments on the newsletter are welcomed.

This issue:

Design Studies Begin for New Polar Research Vessel for NSF

The National Science Foundation (NSF) has initiated a program to assess, and possibly implement, the leasing of a Polar Research Vessel (PRV) to support science in the Antarctic as a replacement for the *NATHANIEL B. PALMER*. As part of that effort, the NSF established a Memorandum of Agreement (MOA) with the Maritime Administration (MARAD), under which various aspects of technical support related to the design of the vessel will be provided. The first such task, now in progress, is to conduct feasibility-level design studies for a new research vessel.

This effort includes the development of vessel design criteria from a set of science and op-

(Continued on page 2)

Visit to Scandinavian Icebreakers

In mid-March 2003, the Polar Research Vessel design team visited the Finnish Maritime Administration and its icebreaker *BOTNICA* as well as the Swedish icebreaker *ODEN*. The purpose of the trip was to gain insight into the design and operation of some of the innovative icebreakers in the Baltic. The icebreakers have advanced hull forms, propulsion systems, and specialized capabilities. These include ice shedding bow

(Continued on page 5)

Some members of the Polar Research Vessel design team observing icebreaking operations aboard the Swedish icebreaker *ODEN* in the Gulf of Bothnia, March 2003. Left to right: Paul Olsgaard, RPSC; Al Sutherland, NSFOPP; Alex Iyerusalimsky, STC; Jim St. John, STC; Captain Anders Backman, Swedish Maritime Administration; and Dick Voelker, MARAD.

(Continued from page 1)

Design Studies Begin

erational requirements that evolved from a series of recent workshops. Current requirements include, among others, the need to conduct acoustic profiling and bottom mapping during icebreaking, the towing of nets and instruments from the stern during icebreaking and the ability to conduct Autonomous Underwater Vehicle (AUV) and Remotely Operated Vehicle (ROV) operations and geotechnical drilling from a moon pool. In addition to these requirements, the vessel should be: 1) acoustically quiet, 2) incorporate environmentally sensitive design features such as reduced air emissions from diesel engines and incinerator operations, 3) comply with the new International Maritime Organization (IMO) guidelines for Arctic vessels, 4) accommodations for 50 scientists, 5) an 80-day endurance, and 6) enhanced icebreaking capabilities.

To achieve the desired science and operational requirements, several special technical studies will be performed to better understand the implications of the requirements on the vessel design and cost. The studies and project milestones are shown in the following figures.

(Continued on page 6)

Special Technical Studies

1. Towing in ice – seismics and nets. Recommend a hull form, stern arrangement, and propulsion system that improves towing in ice.
2. Bathymetry in ice – Recommend a hull form and appendages that promote improved ice management and reduce bubble sweep down over the acoustic windows for the multi-beam swath bottom mapping system, sub-bottom profilers, ADCP, fish finding sonars, and other acoustic sensors.
3. Geotechnical drilling – Recommend a hull form, propulsion system, thruster system, and drilling arrangement for shallow water drilling in landfast ice and open water.
4. Establish requirements for a moon pool to deploy and recover ROVs and AUVs in ice and consider CTD/rosette deployment through the moon pool.
5. Evaluate increased icebreaking capability and evaluate one or more propulsion concepts to satisfy mission requirements and develop recommendation.
6. Examine compliance with new IMO requirements for Arctic vessels including the provision for no pollutants to be carried directly against the outer shell.
7. Investigate and recommend an approach to improve the ship's self-generated noise signature and to improve scientific acoustic sensor performance.
8. Analyze and recommend an approach on methods to reduce emissions from diesel engines and the incinerator.

Project Milestones

Project started on March 11, 2003

1) End of April 2003
   a. Trip report on the visit to Baltic icebreakers and AWI
   b. Outline of vessel technical specification (feasibility-level design studies)
   c. Presentation of work at ARVOC meeting - May 1 and 2
2) End of May 2003
   a. Interim report on the special design studies
   b. Meet with RPSC and geotechnical drilling contractor
3) End of June 2003
   a. Final report on the special design studies
   b. Draft of the design arrangements and hull form
4) End of July 2003
   a. Design history
   b. Design technical specifications
   c. Design drawings
   d. Cost estimate
5) A presentation to NSF, RPSC and ARVOC is scheduled for July 30 and August 1.

Status of the Design Effort

Although some design decisions have been made that satisfy the scientific and operational requirements, there are several issues that must undergo further study. One of the scientific requirements that has a major impact on the design is the size of the moon pool and the adjacent area for winches, supplies, and support equipment.

For example, the moon pool, while originally considered for geotechnical drilling, has been expanded to include the ability to support CTD, ROV, AUV, and diving operations. The size of the moon pool to satisfy these scientific needs is 16 ft by 20 ft with the ROV requirement being the largest.

Moreover, it appears that twin podded propulsors are superior for the range of scientific and operational requirements currently envisioned. While the exact horsepower is being studied, a number of other investigations will have to be undertaken including underwater electromagnetic interference and noise.

NATHANIEL B. PALMER (Length Overall 308 ft, Beam 60 ft, Draft 21.8 ft, Displacement 6,500 Tons, and 12,700 Shaft Horsepower)

USCGC HEALY (Length Overall 420 ft, Beam 82 ft, Draft 29.3 ft, Displacement 16,000 Tons, and 30,000 Shaft Horsepower)

Additionally, icebreaking capability and endurance are being studied. Because of the need to operate in the thick, landfast ice of Antarctica and with some possible missions to the Arctic, the vessel will be designed for operation in multiyear ice with approximately 4.5 ft first-year level icebreaking capability at 3 knots. This capability will be substantially more than the *NATHANIEL B. PALMER* (3.5 ft) and should be similar in capability to the *USCGC HEALY* and *CCG LOUIS S. ST. LAURENT*.

Development of the parent hull form has been completed and it incorporates a box keel of 3.0 ft depth that will contain the bot-

(Continued on page 4)

(Continued from page 3)

Status of Design Efforts

tom mapping transducers and other echo sounding systems. This system has been demonstrated aboard *POLARSTERN* to avoid bubble sweep down over the transducer array and to permit bottom mapping during icebreaking operations. The bow form also reflects recent research on improving icebreaking capability.

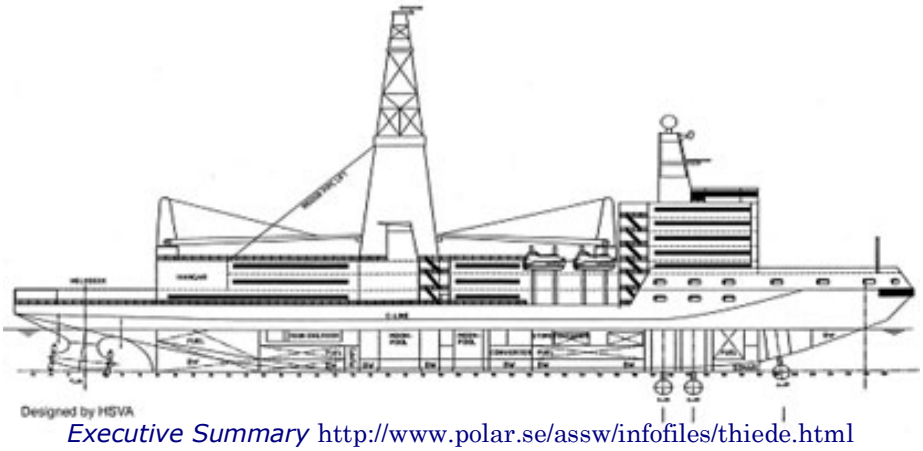
CCG LOUIS S. ST. LAURENT (Length Overall 392.5 ft, Beam 79.9 ft, Draft 31.2 ft, Displacement 14,500 Tons, and 24,000 Shaft Horsepower)

POLARSTERN (Length Overall 387 ft, Beam 82 ft, Draft 34 ft, Displacement 15,000 Tons, and 17,000 Shaft Horsepower)

Current requirements also include a seakeeping performance equal to that of the *NATHANIEL B. PALMER*. The station keeping requirements for the geotechnical drilling are in development.

European Drilling Research Icebreaker

The European Polar Board, with AWI leading the effort, has endorsed the plan to design and build in the context of an European consortium, a drilling vessel capable of operations in Arctic pack ice. The vessel is reported to have two moon pools approximately 13 ft by 16 ft to support drilling and AUV/ROV operations. The vessel has been named *AURORA BOREALIS* and is expected to cost about $250 million. The principal characteristics are: length overall 499 ft, beam 118 ft, draft 28 ft, displacement 23,000 tons and 67,000 shaft horsepower. Additional program information can be found on the web site www.wissenschaftsrat.de/teste/5369-02.pdf



Executive Summary http://www.polar.se/assw/infofiles/thiede.html
Jörn Thiede, AWI, Bremerhaven, Germany

Finnish icebreaker *BOTNICA* in a broken ice channel (Length Overall 317 ft, Beam 78.7 ft, Draft 25.6 ft, Displacement 7,300 Tons, and 13,500 Shaft Horsepower)

(Continued from page 1)

Visit to Icebreakers

forms, podded propulsion systems, and moon pools.

Subsequent to these visits, a one-day meeting was planned with the Alfred Wegener Institute for Polar and Marine Research (AWI), owners of the icebreaking research/supply vessel *POLARSTERN*, in Bremerhaven, Germany. The team's objective was to learn of AWI's experience with box keels which house bottom mapping transducers and other echo sounding instrumention and to discuss other icebreaking research vessel issues.

The visit to the Finnish multipurpose icebreaker *BOTNICA* focused on observations and discussions on the special features of this recently constructed vessel. Among the vessel's features are a 20 ft by 20 ft moon pool designed for both drilling and ROV operations, the use of twin electric podded propulsors (Azipods) built for operations in ice, station keeping, and other features such as an advanced pilot house control station. While onboard, a series of tests were performed in ice that demonstrated the outstanding maneuverability and performance of the podded propulsion system in the prevailing ice conditions.

Of equal importance, was the visit to the Swedish icebreaker *ODEN*. It provided additional insight on ice flow around the vessel with her novel hull form, the use of reamers to improve maneuverability in ice and the effectiveness of the bow water wash system. The broken ice channels behind *ODEN* and *BOTNICA* were similar.

View of Swedish icebreaker *ODEN* (Length Overall 353.7 ft, Beam 101.7 ft, Draft 26 ft, Displacement 11,900 Tons and 23,300 Shaft Horsepower)

At AWI, it was learned that the *POLARSTERN's* box keel (one meter below the vessel's keel) was very effective in minimizing the effect of bubble sweepdown on bottom mapping in open water. Furthermore, the vessel was able to continuously collect data during most icebreaking operations.

Representatives at AWI felt that all ships have the same basic distribution of broken ice behind vessels, regardless of bow form.

A more complete description of the trip, including pictures, observations and conclusions can be found in a presentation given to the Antarctic Research Vessel Operators Committee (ARVOC) on May 1, 2003, in Arlington, VA. A copy is available upon request.

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Web Site Under Construction

Web Site for the PRV Design and Specifications

A web page for the project is under development by RPSC and MARAD and should be operational shortly. It will contain the technical specifications for the vessel with a format suitable for review and comment by the scientific community. The site will also allow reviews and changes to be made on an on-going basis, recognizing that access to make changes will be limited to designated individuals. In addition, this resource will contain links to other sites as well as the results of the current design effort and future editions of this newsletter.

Acronyms

ADCP
Acoustic Doppler Current Profiler
ARVOC
Antarctic Research Vessel Operators Committee
AUV
Autonomous Underwater Vehicle
AWI
Alfred Wegener Institute for Polar and Marine Research
CTD
Conductivity, Temperature, Depth
IMO
International Maritime Organization
MARAD
Maritime Administration
MOA
Memorandum of Agreement
NMREC
National Maritime Resource and Education Center
NSF
National Science Foundation
PRV
Polar Research Vessel
ROV
Remotely Operated Vehicle
RPSC
Raytheon Polar Services Corporation
STC
Science and Technology Corporation

(Continued from page 2)

Design Studies Begin

The design effort is being performed by Science and Technology Corporation's Polar Technology Office under contract to MARAD and in concert with Raytheon Polar Services Corporation (RPSC), who would be responsible for and management of the procurement process for a replacement vessel. The e-mail address of each project team member is shown below.

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